CNG & LNG Safety: Perceptions & Reality
Results of Critical Issues Workshop
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COMMON PERCEPTIONS OF NATURAL GAS AS A VEHICLE FUEL
Past & Present

Perception is Reality
1999 Italian NGV Campaign surveyed 800 people, representative of the Italian drivers population

1999: 260,000 NGVs & ~350 CNG stations

Media Campaign: 3 main newspapers; 8 weekly magazines; 25 monthly magazines (car, science, environment, life style)
Do you think CNG is an attractive motor fuel?

1999 survey

- 75% Yes
- 16% neutral
- 9% No
- 4 Not at all
- 5 Not much
- 16 Neutral
- 46 Much
- 29 Very much

Source: The NGV Market in Italy, Flavio Mariani (ENI) as presented at the 2002 Bayerngas Symposium
Why do you think CNG is attractive?

- **ENVIRONMENT** (72%)
- **COST SAVINGS** (60%)

1999 survey:
- Energy saving: 3
- Alternative fuel: 2
- Good performance: 1
- Praticable: 1
- Other: 3
- I don't know: 2

(More than one answer allowed)

Source: The NGV Market in Italy, Flavio Mariani (ENI) as presented at the 2002 Bayerngas Symposium
Why do you think CNG is NOT attractive?

1999 survey

- It's dangerous: 18
- Not enough filling station: 7
- Poor performance: 7
- Not interested: 6
- It's polluting: 5
- Too much space demanding: 4
- High conversion costs: 3
- Price not competitive: 2
- Lack of advertising: 2
- I run too few km/y: 2
- I'm not accustomed: 1
- It ruins the engine: 1
- Bad experience with NG at home: 1
- It increases fuel consumption: 1
- My car is too small: 1
- Other: 7
- I'm not enough informed about it: 42

(More than one answer allowed)

Source: The NGV Market in Italy, Flavio Mariani (ENI) as presented at the 2002 Bayerngas Symposium
Would you be interested in CNG for your own car?

1999 survey

- 64% Yes
- 16% neutral
- 20% No

Source: The NGV Market in Italy, Flavio Mariani (ENI) as presented at the 2002 Bayerngas Symposium
If not, why?

1999 survey

- It's dangerous: 19
- I run too few km/y: 15
- I'm not interested: 7
- Not enough fuelling station: 7
- Too much space demanding: 6
- My car is too small: 4
- Poor performance: 4
- Price not competitive: 4
- High conversion costs: 4
- It's polluting: 4
- Lack of advertising: 1
- Bad experience with NG at home: 1
- It increases fuel consumption: 1
- My car is too old: 1
- It ruins the engine: 1
- Other: 6
- I'm not enough informed about it: 30

(More than one answer allowed)

Source: The NGV Market in Italy, Flavio Mariani (ENI) as presented at the 2002 Bayerngas Symposium
Italian customers’ appreciation of NGVs:
Safety was a perceived issue in 2005

Source: Italian NGV Scenario 2005, Flavio Mariani, Metauto-ENI Divisione Gas & Power, Cattolica, September 20-21, 2005

2005: NGVs = 380,500
CNG Stations = 500+
Fleet operators opinion survey

Perception of CNG features vs gasoline and diesel

POSSIBILITY OF CIRCULATION IN PERIODS OF TRAFFIC BLOCK
ENVIRONMENTALLY FRIENDLY
THRIFTINESS
SUITABLE TO ALL VEHICLES
PERFORMANCES
AVAILABILITY OF CAR MODELS
AVAILABILITY OF REFUELLING STATIONS

NEGATIVE SCARCE ACCEPTABLE GOOD

CNG
GASOLINE
DIESEL

Source: Italian NGV Scenario 2005, Flavio Mariani, Metauto-ENI Divsione Gas & Power, Cattolica, September 20-21, 2005
# RESULTS

Findings & Conclusions

6th Annual Critical Issues Workshop
CNG & LNG Safety: Perception & Reality

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Brussels, Belgium

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<th>PRINCIPAL SPONSOR</th>
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Safety requirements are imposed along each link in the NGV value chain.

- **Material suppliers**
  - Steel
  - Copper
  - Steel
  - Carbon Fiber
  - Aluminum

- **Component manufacturer**
  - Pipe
  - Valves
  - Fuel tanks
  - Cylinders
  - Fuel Connectors

- **System Developers**
  - OEMs
  - System Packagers
  - Kit Manufacturers
  - Fuel Station Packagers

- **Customers**
  - OEMs
  - Retrofit installers
  - Commercial fleets
  - Commuter vehicles
  - Station Installers

- **Maintenance**
  - Service-Maintenance
  - Repair
  - Inspection & re-certification
  - Station Operators
Weak links along the NGV value chain

- Low quality raw materials
- Inferior components or ‘knock-offs’
- Single unit certification – ‘batch testing’ needed
- Equipment installers at the workshop & maintenance staff are untrained
- Certification officials lack training
- Bribe certification officials
- Human errors
NGV Safety issues have remained constant over time

- **Perception is reality** and NGV safety remains an issue.
- **NGVs are safe**…if you handle them safely.
- **The safety ethic and the concept of ‘quality’ vary widely** from country-to-country.

Source of Images: Rap Clean Vehicle Technology
Technical Issues for CNG Safety

- Installers need to follow appropriate installation codes and instructions from their suppliers.
- Periodic inspections and cylinder recertification are weak links in the safety chain.
- The NGV industry must continue to understand the causes of NGV incidents in order to effect changes in codes/standards, resulting in safer products.
- An automotive-grade corrosion performance test is required in NGV industry standards. (R.110)
- The NGV industry should learn from the hydrogen industry and consider adopting hydrogen vehicle industry practices.
LNG Safety for Road, Sea and Rail

- There are potential hazards as well as safeguards at each stage of the LNG supply chain.
- Lessons learned from industrial LNG applications are applied to transport sectors.
- Marine sector NGV standards are emanating from the top down.
- The rail sector use of LNG is in its infancy and mostly is prohibited except through exemptions and for purposes of ‘proof of concept.’
Design and Safety of CNG and LNG Fuelling Systems

- Development of natural gas as a marine fuel will depend on the development of robust safety standards and regulations for bunkering (fuelling ships) and related activities.*

- Proving safety through hazardous operations studies (HAZOP) is being done on a case-by-case, location-by-location basis, which is very expensive and time-consuming.

- There are no standards or regulations for mobile fuelling stations.

*ISO TS 18683: Guidelines for Systems & Installations to Supply LNG as a Fuel for Ships
Conclusions

 Changing perceptions into reality is a necessary and on-going process that needs continued attention and effort.

• A process to systematically track CNG incidents internationally would promote continued learning and safety.

• ‘Best practices’, sharing experiences of stakeholders and preparing good documents for broad dissemination could be a good way to introduce safety concepts that are not necessarily in the context of legal regulations or even standards.
Conclusions

Harmonization of standards and regulations as well as vigilant implementation and enforcement within each NGV sector will continue to be a challenge but should be a long-term priority that will promote safety, reliability, and reduce costs for manufacturers and customers.

- The NGV industry must police itself to ensure safe system designs and safe products.
- Countries entering the NGV market should look to the highest level of international standards and regulations – ISO and UNECE – as the best models to guide the safe adoption of equipment, whether it is for the road, marine or rail sectors. Countries should not ‘borrow’ regulations from other countries.
Conclusions

Training is critical, desired and available but costly. The NGV and safety expertise needs to reach more people throughout the NGV value chain who need it the most in order to help provide safe equipment and practices to all NGV markets.

The cost frequently is something the stakeholders are not willing to pay for.
Final Conclusion

Expanding cooperation between the advocates and stakeholders supporting the different NGV technologies and fuel sectors – CNG, LNG & biomethane for road, off-road, marine and rail applications -- will speed the market entry and commercialization of methane throughout all the transportation sectors.

Cross fertilization of knowledge, expertise and experience between the transport sectors (road, marine and rail) is possible but it likely will involve cooperation via industry associations and standards and regulatory organizations at the various levels, international, regional and national.
International institutions & associations supporting gaseous fuel propulsion – *NGVs, marine, rail* -- must work together.

- Regional Associations
- International Industry Associations
- National Associations
- Standards Institutions (ISO – CEN etc.)
- Regulatory Institutions (UNECE-IMO etc.)
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Complete Results paper available by visiting: www.cleanfuelsconsulting.org

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